

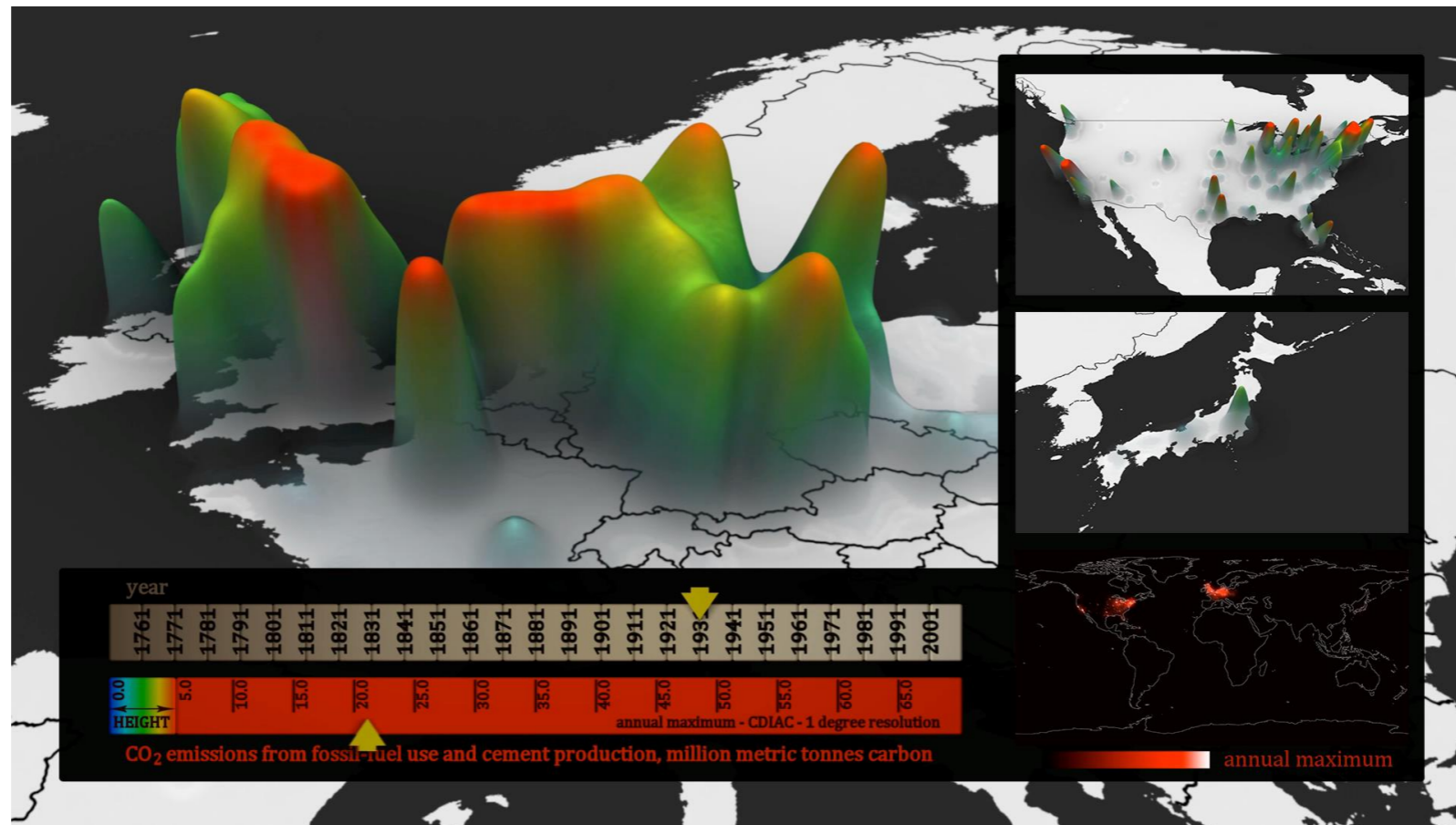
# Maximizing Trade-Offs Among Social, Environmental, and Economic Benefits



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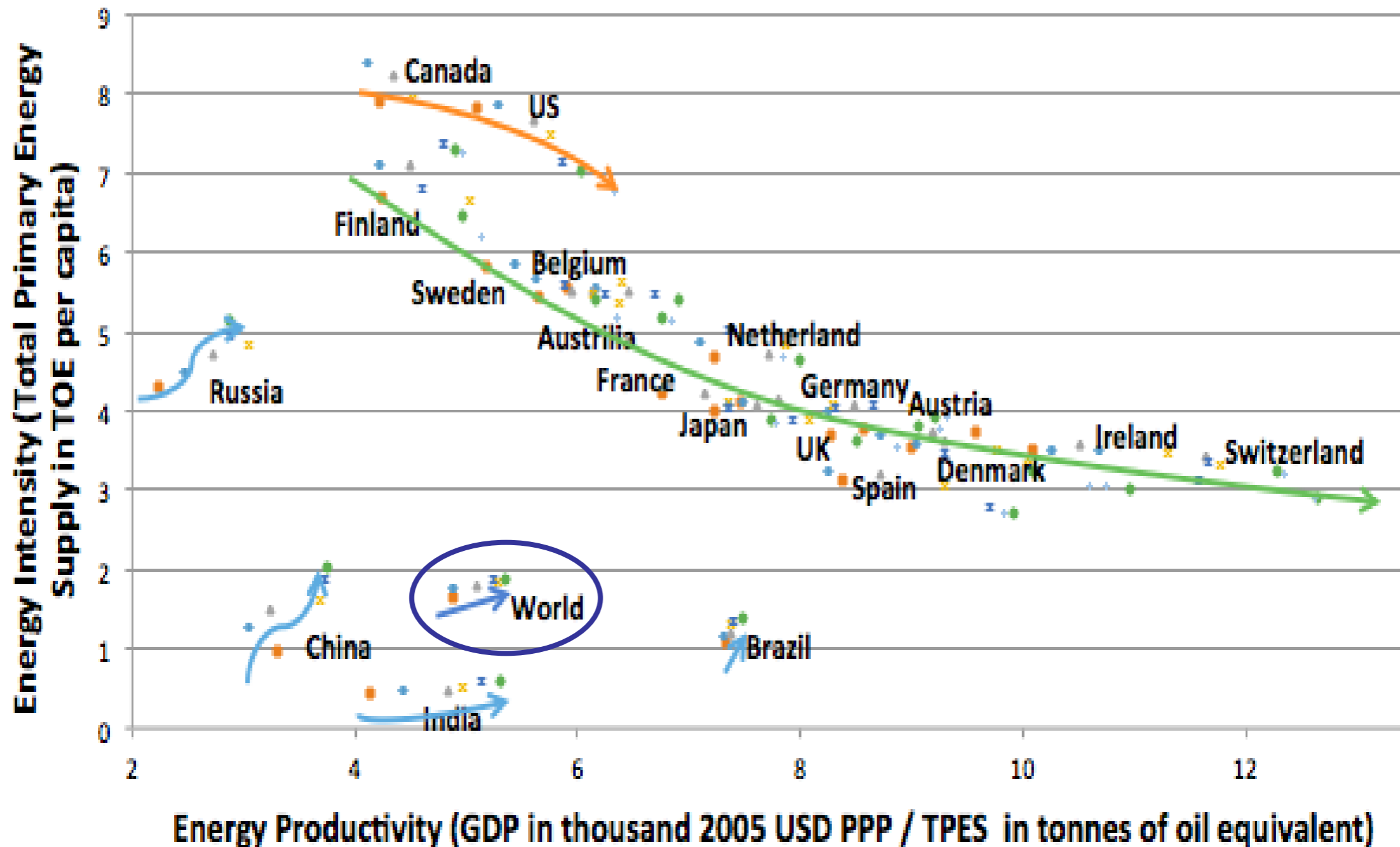
# CO<sub>2</sub> Emissions Track Urban Development



CO<sub>2</sub> emission (1751–2006)

Source: ORNL Climate Change Science Institute

# National carbon footprints illustrate the need for alternative development pathways



Source: Brown, Marilyn A. 2014. "Enhancing Efficiency and Renewables With Smart Grid Technologies and Policies," *Futures: The Journal of Policy, Planning and Futures Studies*, 58: 21-33.

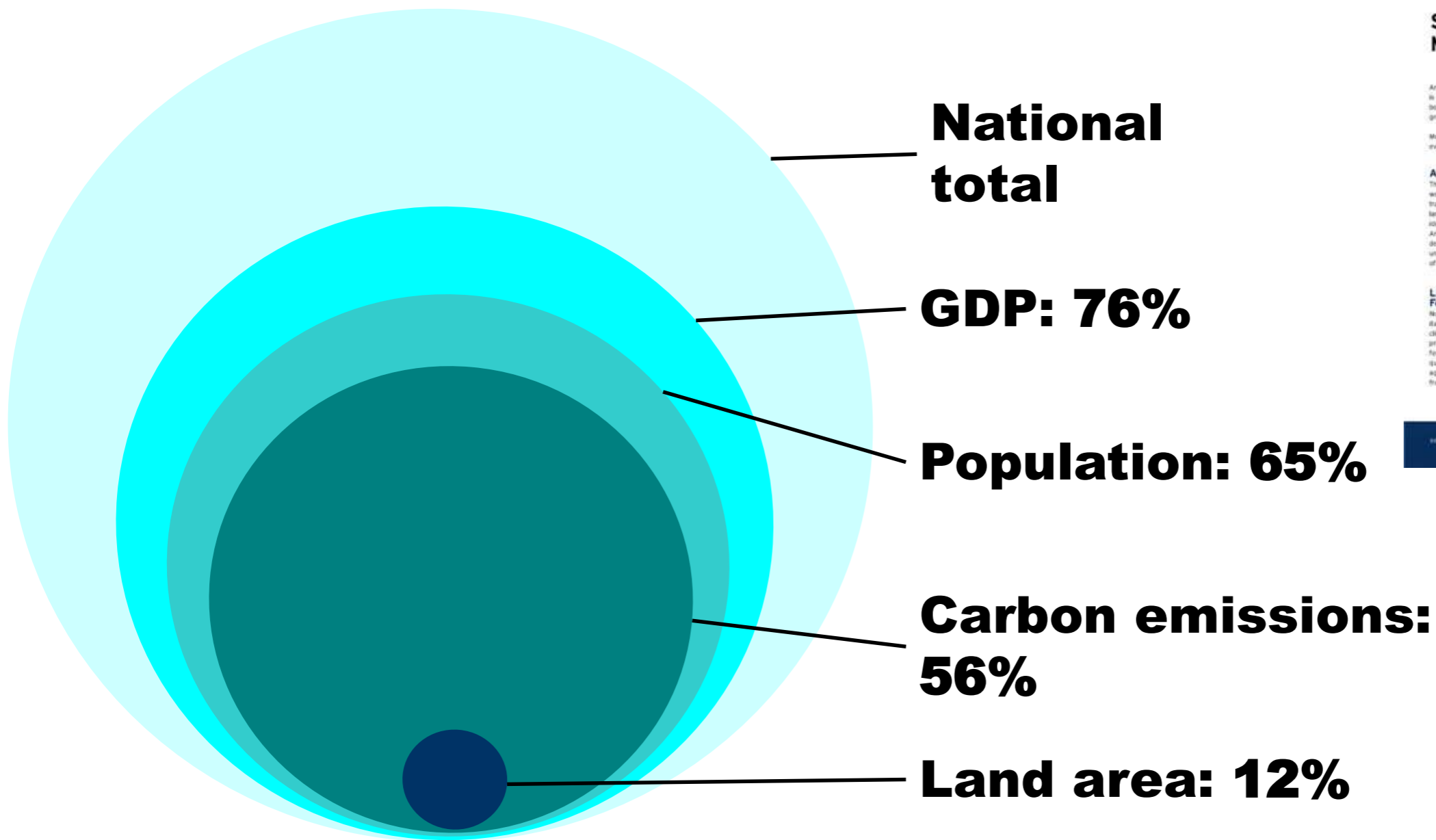
# **Why the Concern With Local Initiatives?**

## **What's New Here?**

- Most of the activity driving energy consumption occurs in metro areas
- Successful energy management must create city-level behavioral changes
- Comprehensive inter-jurisdictional comparisons have not been possible from prior efforts

# Cities offer the potential for improving energy and carbon efficiency

## Percentage of national activity in 100 largest metro areas, 2005



### Shrinking the Carbon Footprint of Metropolitan America

Marilyn A. Brown, Frank Southworth, and Andrea Sarzynski

America's carbon footprint is expanding. With a growing population and an expanding economy, America's settlement area is sprawling, and as it does, Americans are driving more, building more, consuming more energy and emitting more carbon. Rising energy prices, growing dependence on imported fuels, and accelerating global climate change make the nation's growth patterns unsustainable.

Metropolitan America is poised to play a leadership role in addressing these energy and environmental challenges. However, federal policy actions are needed to achieve the full potential of metropolitan energy and climate solutions.

#### America's Challenge

The nation's carbon footprint has a distinct geography not well understood or often discussed. This report quantifies transportation and residential carbon emissions for the 100 largest U.S. metropolitan areas, finding that metro area residents have smaller carbon footprints than the average American. However, metro footprints vary widely. Population density and the availability of public transit are important to understanding carbon footprints, as are the carbon intensity of electricity generation, electricity prices, and weather.

#### Limitations of Existing Federal Policy

Numerous market and policy distortions inhibit metropolitan actors from more aggressively addressing the nation's climate challenge. Economy-wide problems include underpriced energy, underfunded energy research, missing federal standards, distorted utility regulations, and inadequate information. Policy impediments include a bias against public transit, inadequate federal leadership on freight and land-use planning, failure to encourage energy

and location-efficient housing decisions, and the fragmentation of federal transportation, housing, energy, and environmental policies.

#### A New Federal Approach

Federal policy could play a powerful role in helping metropolitan areas—and to the nation—shrink their carbon footprint. In addition to economy-wide policies to motivate action, five targeted policies are particularly important within metro areas and for the nation as a whole:

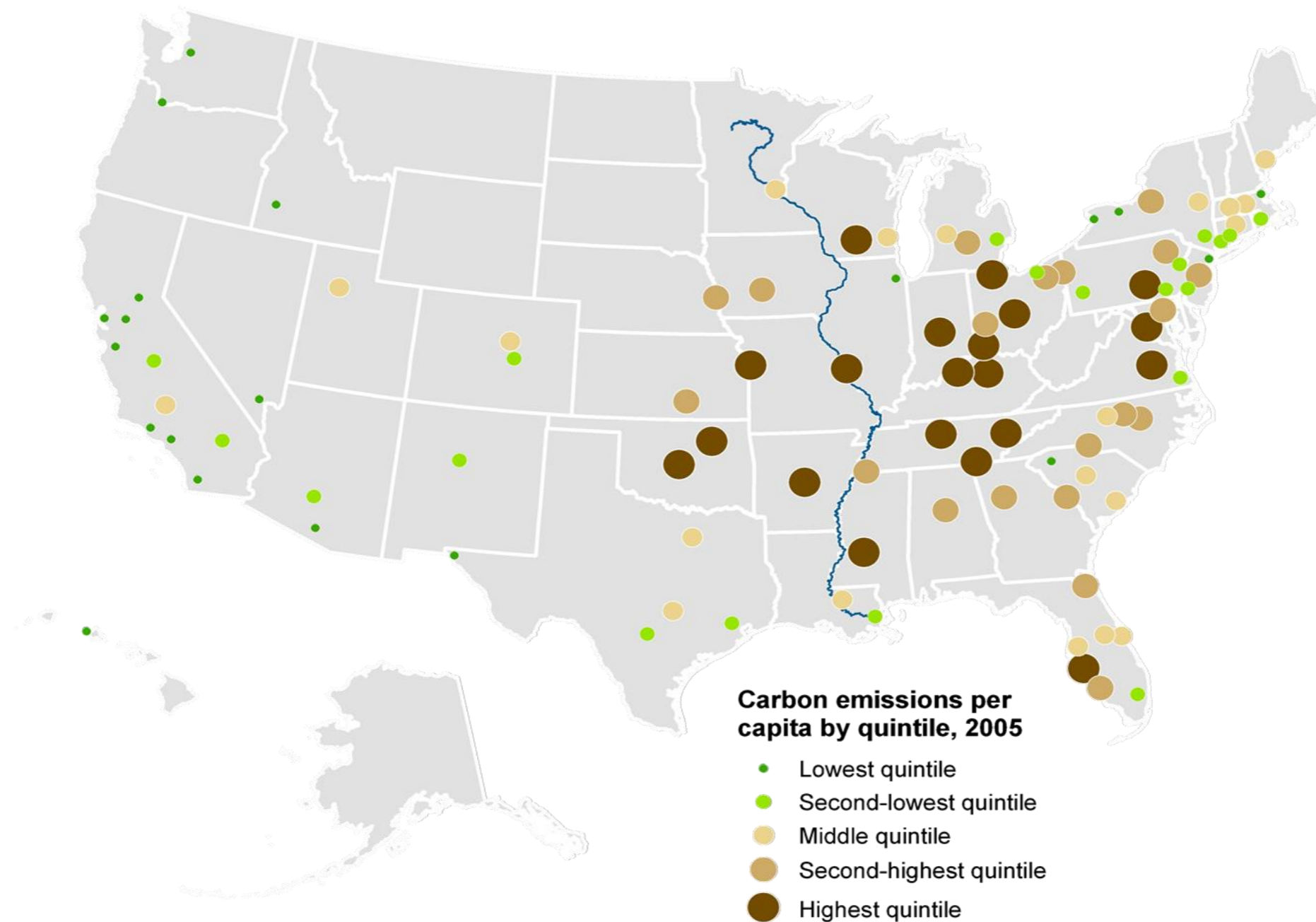
- **Promote more transportation choices** to expand transit and compact development options.
- **Introduce more energy-efficient freight operations** with regional freight planning.
- **Require home energy cost disclosure when selling and "tax-bill" financing** to stimulate and scale up energy-efficient retrofitting of residential housing.
- **Use federal housing policy** to create incentives for energy- and location-efficient decisions.
- **Issue a metropolitan challenge** to develop innovative solutions that integrate multiple policy areas.

REVISED: May 2009

Metropolitan Policy Program

www.metropolismatters.org

# The Mississippi River roughly divides the country into high and low CO<sub>2</sub>-emitting metropolitan areas (2005)

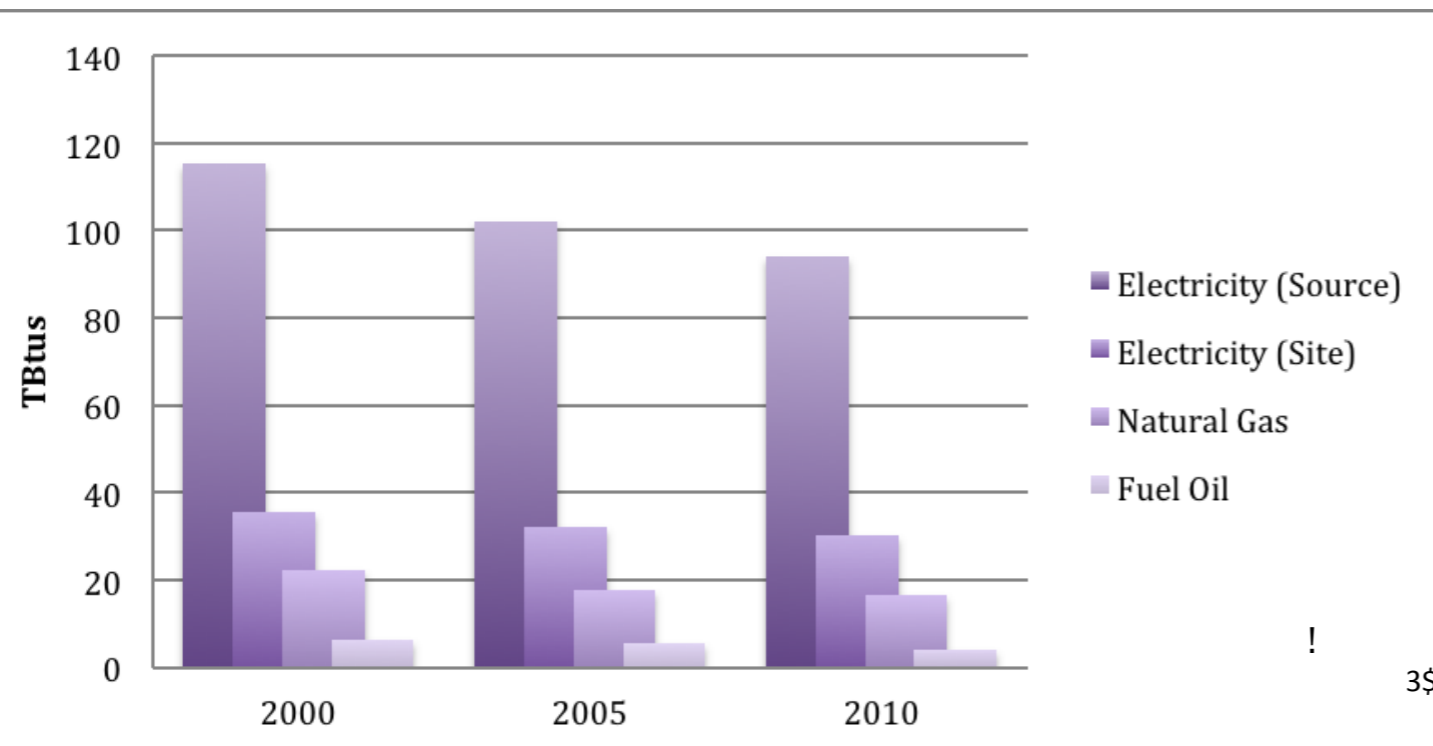


# Fuel mix and electricity prices are important determinants of CO<sub>2</sub> emissions

- The fuel mix used to generate electricity matters in residential footprints
- Lower electricity prices are correlated with larger residential footprints
- Areas with lower residential building carbon footprints tend to be located in mild climates with low heating and cooling requirements

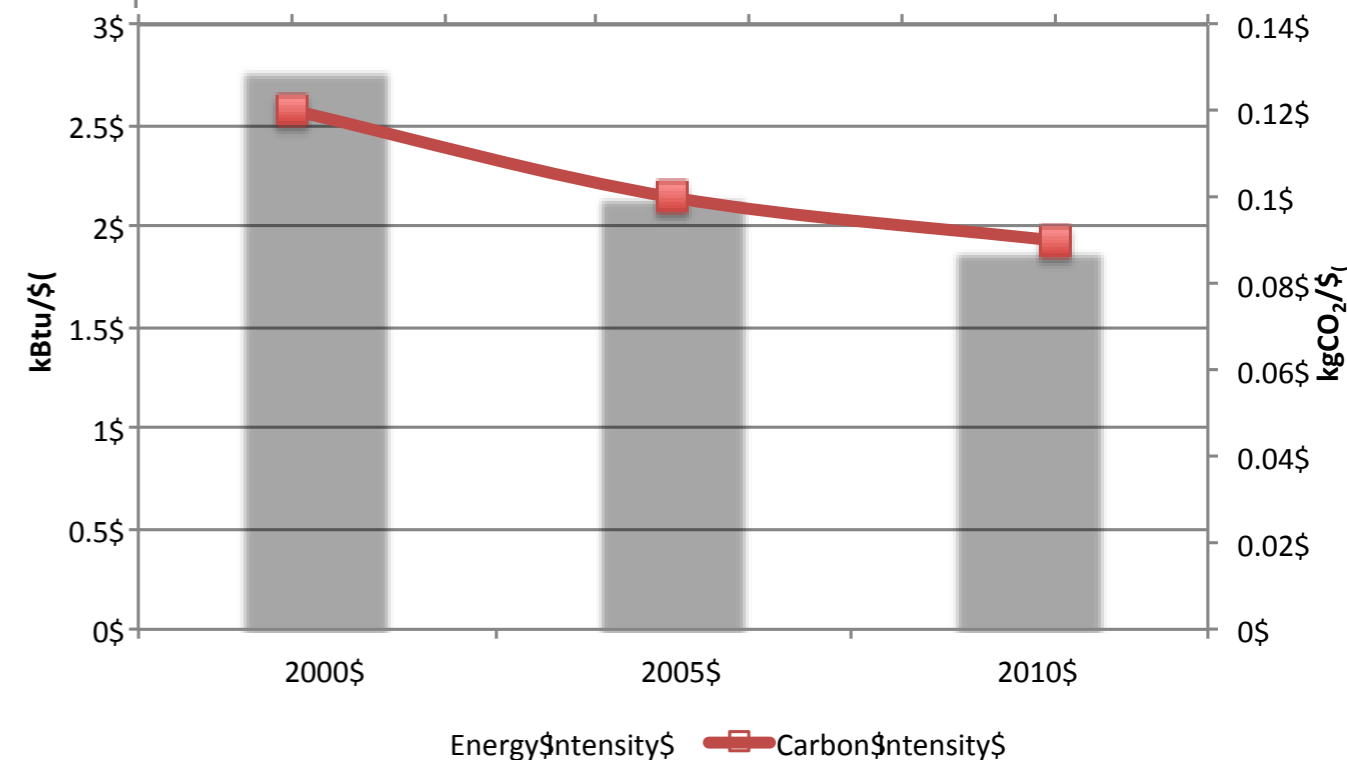
# Electricity Use is Growing in Dominance in Commercial Buildings

## Extension of Analysis to 2010 Led by Matt Cox (Georgia Tech)



- The reliance on electricity is increasing relative to the direct use of natural gas in commercial buildings.

- While CO<sub>2</sub> emissions per \$ GDP are declining on average, the importance of managing electricity consumption as a means to manage CO<sub>2</sub> emissions is increasing.





# Commercial Buildings Energy Intensity of Metro Areas is Variable: 2000-2010

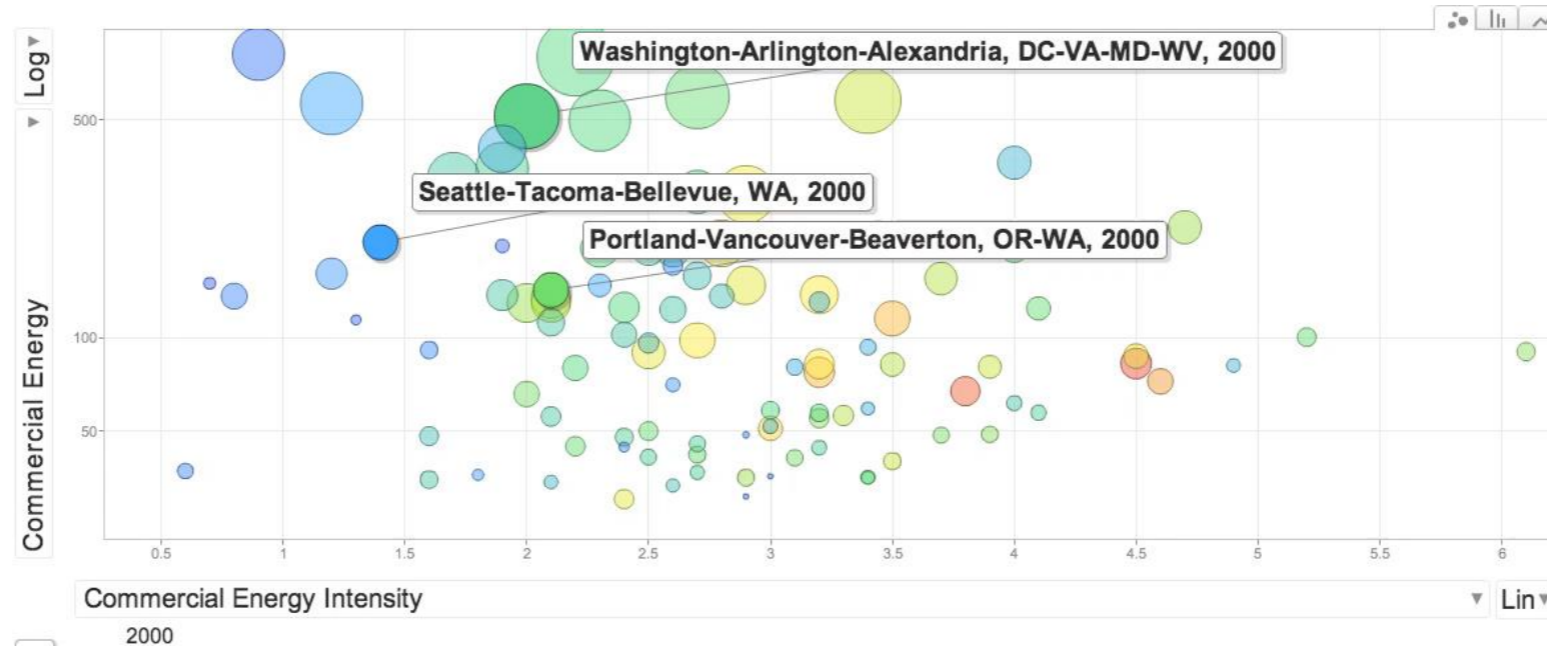
Commercial energy intensity (measured in energy consumption per GDP), by building type and overall, allow for similar comparisons as in the residential sector (measure in energy consumption per capita).

Total energy intensities range from 0.4 kBtu/\$-2005 (Bridgeport CT, 2010) to 6.1 kBtu/\$-2005 (Durham NC, 2000).

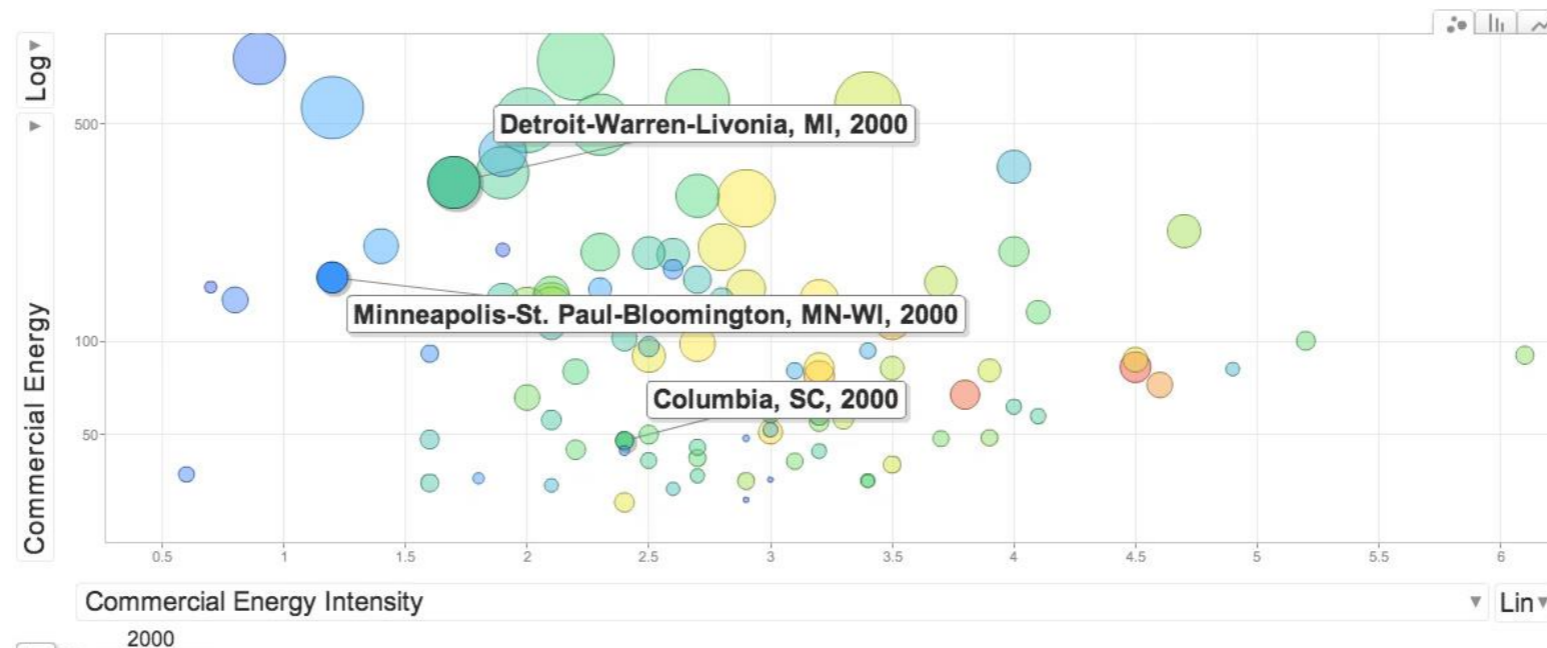
Cox, Matt and Marilyn Brown. 2014. "Sustaining the City: Trends in Energy and Carbon Management in Large US Metros." *Proceedings of the American Council for an Energy Efficient Economy (ACEEE) Summer Study on Energy Efficiency in Buildings, Pacific Grove, CA.*

# Commercial Buildings Energy Intensity of Metro Areas is Variable: 2000-2010

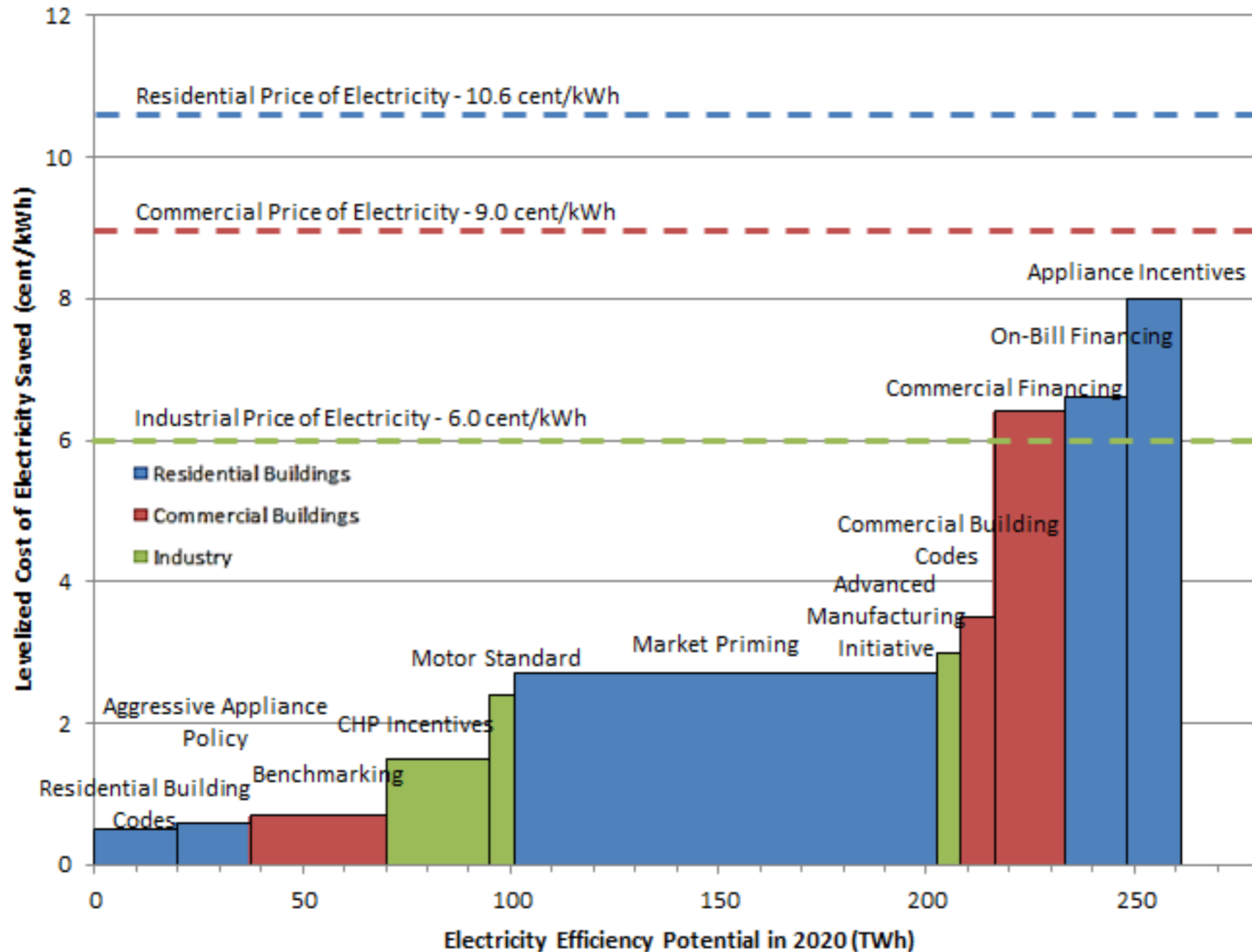
Most Improved MSAs



Least Improved MSAs



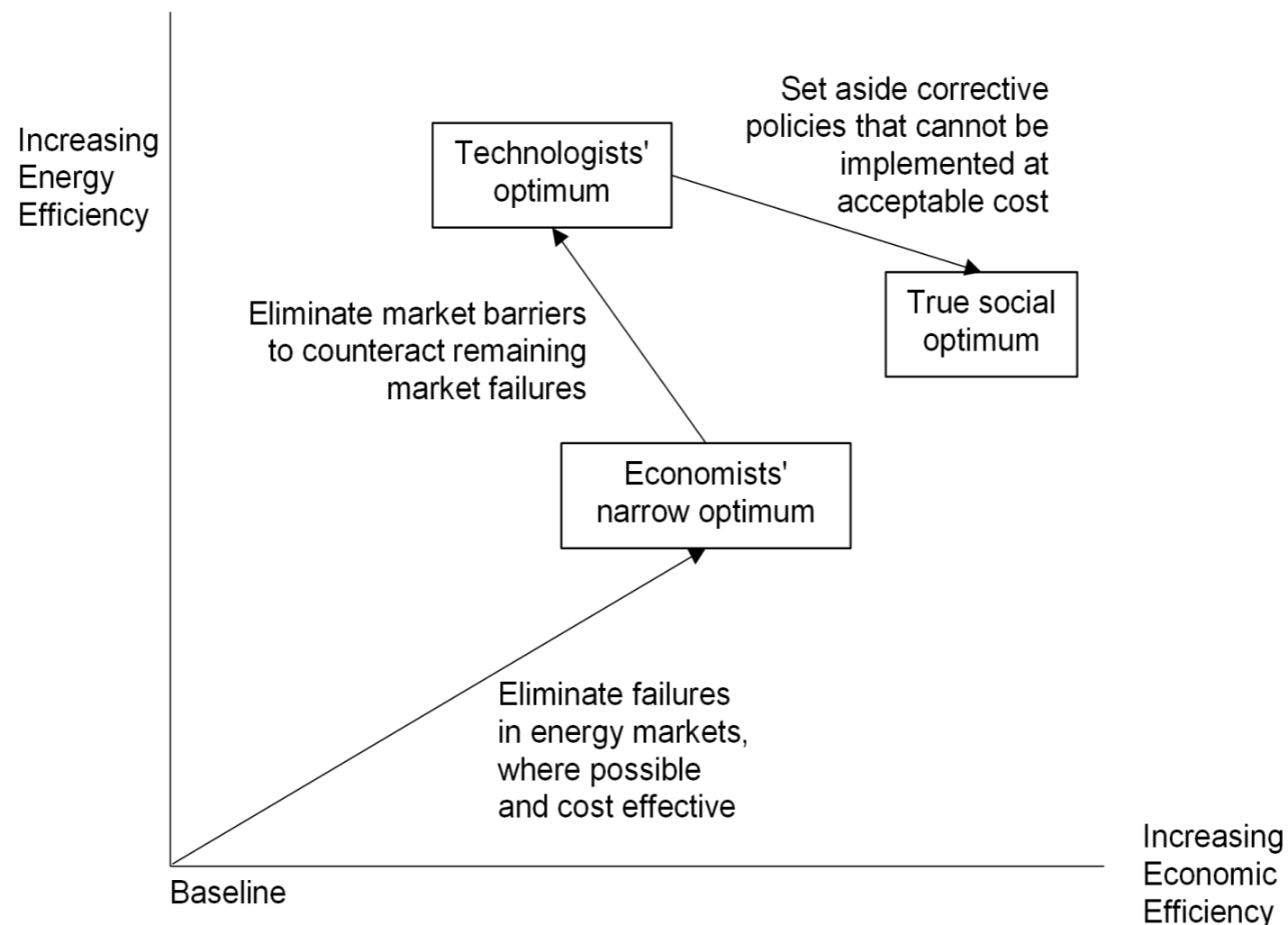
# Policies are Needed to Deliver Energy & Carbon Efficiency



## U.S. Supply Curve for Electricity Efficiency Resources

Source: Wang, Yu and Marilyn A. Brown. 2014. "Policy Drivers for Improving Electricity End-Use Efficiency in the U.S.: An Economic-Engineering Analysis". *Energy Efficiency*, 7(3): 517-546.

# Alternative Notions of the Energy-Efficiency Gap



The market failure and public interest rationales for public policy intervention

Source: Marilyn A. Brown and Yu Wang. *Green Savings: How Policies and Markets Drive Energy Efficiency* (San Francisco: Praeger, 2015, forthcoming).

# You Can't Manage what you Can't Measure

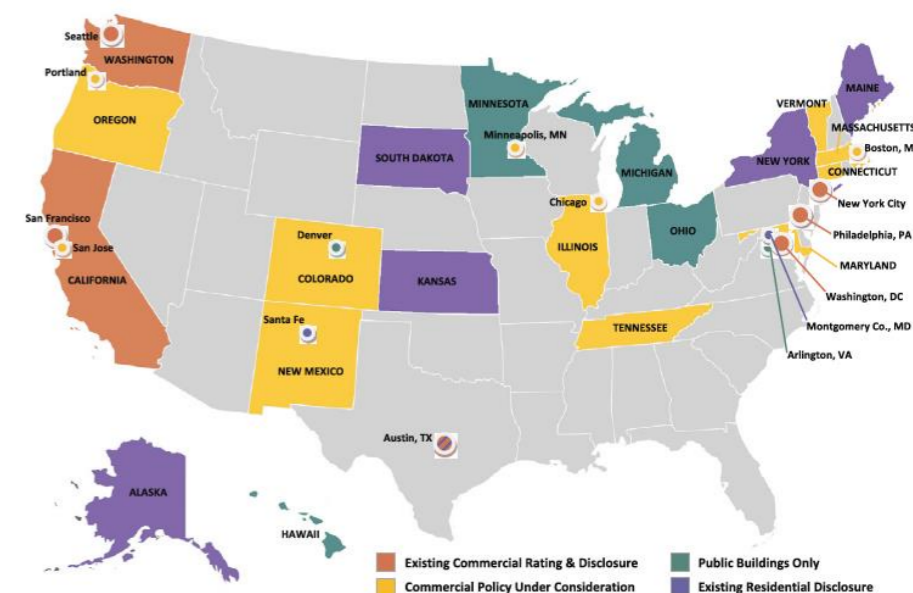
Smart meters with fiber optics:

- ✓ Can interface with in-home or in-office displays of online consumption data
- ✓ Enables dynamic pricing

Commercial building benchmarking:

- ✓ Mandated disclosure and benchmarking efforts in the US can reduce discount rates anywhere from 3 to 22 percent
- ✓ While Europe has used mandated disclosure and benchmarking programs for many years
- ✓ Mandated disclosure programs require utilities to submit energy data on all tenants in a standard format to a widely used database. EPA's Portfolio Manager

Nest thermostat



# Cost-Effectiveness of Benchmarking

- Benchmarking could produce significant energy and emissions benefits to the nation, the vast majority of which would occur in urban areas.
- Smart combinations of benchmarking with other policies could yield positive synergistic effects
- Spillovers could also be large, as the policy would enable other actions

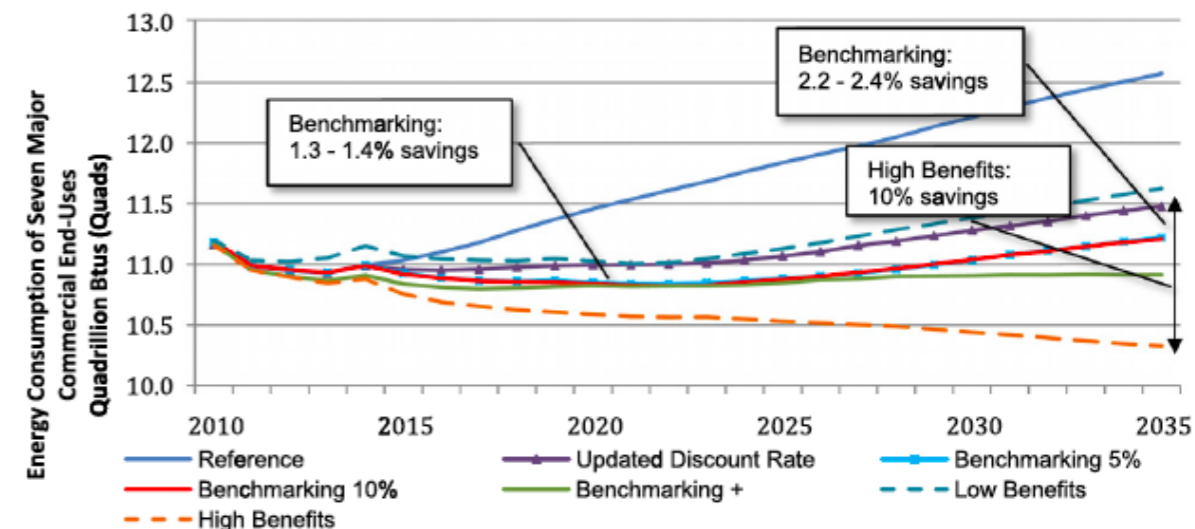


Table 2. Benefit–cost analysis of commercial sector benchmarking<sup>a</sup> (billion 2009-\$).

Year	Cumulative social benefits				Cumulative social costs			Cost–benefit analysis
	Energy expenditure savings	Value of avoided CO <sub>2</sub>	Value of avoided criteria pollutants	Lower equipment outlays	Total benefits	Compliance costs	Total costs	Net social benefits
2020	6.3–2.8	–0.4–0.1	1.4–3.4	6.4–5.4	13.7–11.7	0.1	0.1	
2035	28.3–22.0	0.6–1.6	3.1–7.3	18.0–21.7	50.0–52.6	0.1	0.1	
Total impact <sup>b</sup>	39.7–31.7	0.9–2.3	3.0–8.2	18.0–21.7	61.5–63.8	0.1	0.1	61.4–63.7

# Grounds for Optimism

- Carbon emissions are just beginning to be priced – “market signals” will spur innovation.
- Most of the 2050 physical plant is not yet built – with growth comes opportunity.
- States and localities are moving ahead.
- And grass roots action is available to all.

